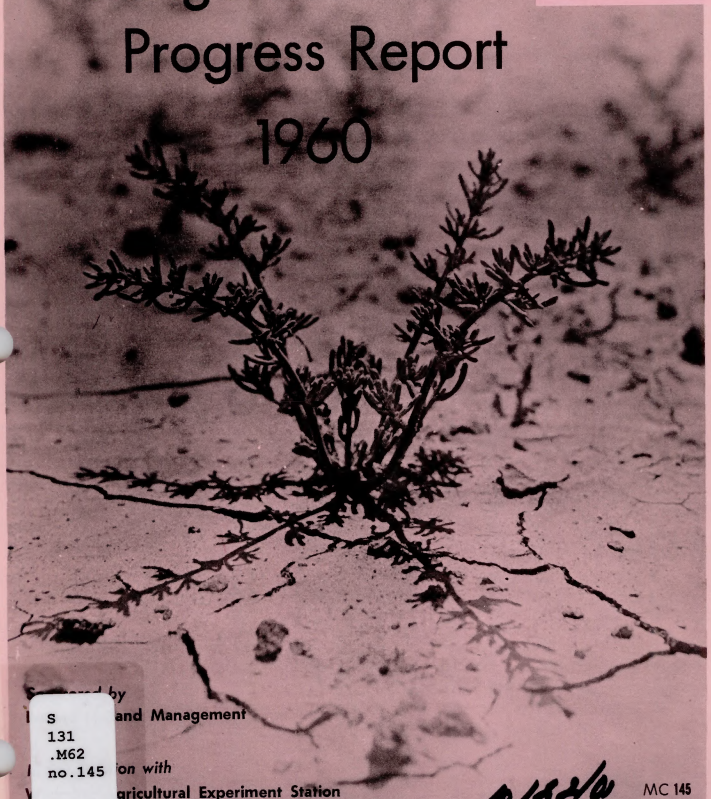
Range Research Progress Report 1960



MC 145

RANGE MANAGEMENT

by

L. Christian Vosler & Dixie R. Smith[1/]

Intensity of Grazing Study

Experimental pastures were established in 1956 to determine the effect of different intensities of grazing upon the spread on containment of halogeton (Halogeton glomeratus). The study area is located fifteen miles north of Greybull, Wyoming (T 53N, R 95W, Sec. 3). The vegetation within the pastures is dominated by saltsage (Atriplex nuttallii) and is considered typical of much of the winter sheep range in the Big Horn Basin.

The combined pastures are one mile square and are divided into seven individual units, one of which is used as a holding pasture for experimental animals. The other six pastures are arranged in a modified randomized block design in which each of three grazing intensities appears in the two adjacent blocks. The grazing intensities and desired rates of forage utilization are as follows: light, 20 percent; moderate, 40 percent; and heavy, 80 percent.

Production of saltsage was estimated in each pasture by clipping 20 plots, each 100 square feet in area. Utilization was determined by clipping an additional 20 plots after all animals had been removed. Cover estimates of shrubs were obtained by the coordinate method of Pickford and Reed (1935) from ten permanent quadrats, each 2 x 20 feet, in each of the pastures. Estimates of herbaceous cover were made by the point method (Levy and Madden, 1933) on ten permanent plots, each 4 x 4 feet using ten frames of ten pins each.

Production of saltsage (Table 1), during the 1959-60 growing season, was limited by severe drought. Decreases were noted in all pastures but relative decreases were most pronounced under heavy use. Here production was only 34 percent of the 1958-59 yield, as compared to about 50 percent under moderate or light use.

The vegetation was an almost pure stand of saltsage with minute quantities of forbs and grasses (Table 2). Saltsage was most abundant within the exclosures, but no significant difference existed between the three intensities of grazing. A more detailed analysis of saltsage cover is presented in Appendix I.

Halogeton continued to spread over the entire study area (Figure 1). Overall densities remain low and frequency of occurrence within the pasture system is only ten percent (as measured from the permanent 4.4 feet quadrats).

Mr. Howard Flitner of Shell, Wyoming, supplied 445 head of ewes and five bucks for use as experimental animals. Seventy-four ewes and one buck were individually weighed and placed in each of the pastures. Adequate water was supplied at all times.

1/ Research Assistant and Assistant Professor of Range Management, respectively, Wyoming Agricultural Experiment Station.

RANGE MANAGEMENT

by

L. Christian Vavra & Dixie R. Smith[1/]

Intensity of Grazing Study

Experimental pastures were established in 1939 to determine the effect of different intensities of grazing upon the spread on cooperment of Halogeton (Halogeton glomeratus). The study area is located fifteen miles north of Cheyenne, Wyoming (T 23N, R 62W, Sec. 3). The vegetation within the pastures is dominated by saltsage (Artiplex nuttalli) and is considered typical of much of the winter sheep range in the Big Horn Basin.

The completed pastures are one mile square and are divided into seven individual units, one of which is used as a holding pasture for experimental animals. The other six pastures are arranged in a modified randomized block design in which each of three grazing intensities appears in the two adjacent blocks. The grazing intensities and desired rates of forage utilization are as follows: light, 20 percent; moderate, 60 percent; and heavy, 80 percent.

Production of saltsage was estimated in each pasture by clipping 20 plots, each 100 square feet in area. Utilization was determined by clipping an additional 20 plots after all animals had been removed. Cover estimates of shrubs were obtained by the coordinate method of Pickford and Reed (1932) from ten permanent quadrats, each 2 x 20 feet, in each of the pastures. Estimates of herbaceous cover were made by the point method (Levy and Madden, 1933) on ten permanent plots, each 4 x 4 feet using ten lances of ten pins each.

Production of saltsage (Table 1), during the 1939-60 growing seasons, was limited by severe drought. Decreases were noted in all pastures but relative decreases were most pronounced under heavy use. Here production was only 14 percent of the 1938-39 yield, as compared to about 50 percent under moderate or light use.

The vegetation was an almost pure stand of saltsage with minute quantities of forbs and grasses (Table 2). Saltsage was most abundant within the ovelcourse, but no significant difference existed between the three intensities of grazing. A more detailed analysis of saltsage cover is presented in Appendix I.

Halogeton continued to spread over the entire study area (Figure 1). Overall densities remain low and frequency of occurrence within the pasture system is only ten percent (as measured from the permanent 4x4 foot quadrats).

Mr. Howard Flitner of Shell, Wyoming, supplied 665 head of ewe and five bucks for use as experimental animals. Seventy-four ewes and one buck were individually weighed and placed in each of the pastures. Adequate water was supplied at all times.

1/ Research Assistant and Assistant Professor of Range Management, respectively, Wyoming Agricultural Experiment Station.

TABLE 1. PRODUCTION OF SALTSAGE UNDER DIFFERENT INTENSITIES OF GRAZING (AIR-DRY FORAGE PER ACRE).

Pasture No.	Light Use 4	7	Moderate Use 1	5	Heavy Use 2	6	Mean
1958	166.8	165.9	136.8	186.7	117.1	184.8	
Mean	166.4		161.8		150.9		159.7
1959	225.9	221.1	212.9	255.9	107.5	235.8	
Mean	223.5		229.4		203.2		209.9
1960	129.2	95.6	106.3	108.9	71.7	67.9	
Mean	112.4		107.6		69.8		96.6

TABLE 2. PERCENTAGE VEGETATIVE COVER, UNDER DIFFERENT INTENSITIES OF GRAZING, 1960.

Pasture No.	Light Use 4	7	Moderate Use 1	5	Heavy Use 2	6	Exclosures
Species:							
Atriplex nuttallii	12.5	13.7	14.7	11.0	7.5	12.3	18.5*
Abronica elliptica							0.05
Allium textile	0.6		0.7	0.1	0.1	0.2	0.05
Halogeton glomeratus	3.4	8.6				6.3	4.35
Koeleria cristata			0.1				0.15
Lappula occidentalis				0.1	0.1	0.2	0.05
Lepidium virginicum							0.05
Oryzopsis hymenoides			0.1			0.3	
Pteryxia terebinthina			0.1	0.1		0.1	
Salsola kali						0.1	
Sisymbrium linifolium			0.1				
Sitanion hystrix				0.7		0.1	0.05
Sphaeralcea coccinea			0.1			0.1	
Sophia pinnata	0.5						0.05
Stanlyea viridiflora						0.1	

* No significant difference between the three intensities of grazing.

TABLE 1. PRODUCTION OF SAITAJOK UNDER DIFFERENT INTENSITIES OF GRAZING (AIR-DRY POUNDS PER ACRE).

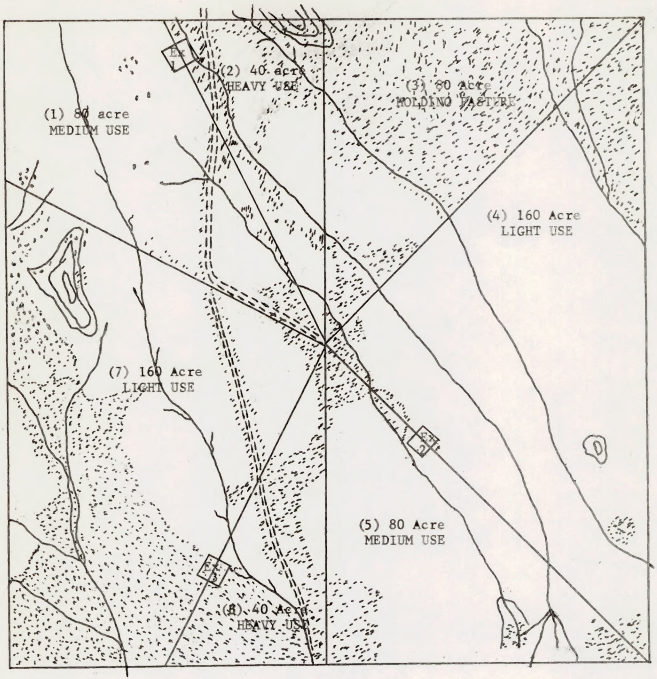
Pasture No.	Light Use		Moderate Use		Heavy Use		Mean
	2	7	1	5	4	6	
1958	185.8	165.9	136.8	186.7	117.1	194.8	
Mean	166.4		161.8		150.9		159.7
1959	225.9	221.1	212.9	255.0	197.5	215.8	
Mean	223.5		229.4		203.2		209.9
1960	129.2	95.6	106.3	108.9	71.7	67.9	
Mean	112.4		107.6		69.8		96.4

TABLE 2. PERCENTAGE VEGETATIVE COVER, UNDER DIFFERENT INTENSITIES OF GRAZING, 1960.

Species No.	Light Use		Moderate Use		Heavy Use		Ungrazed
	3	7	1	5	4	6	
Agropyron	12.5	13.7	14.7	11.0	7.5	12.3	18.3*
Agrostis elliptica							0.05
Allium textile	0.6		0.7	0.1	0.1	0.2	0.05
Halogeton glomeratum	3.4	8.6				8.3	4.35
Koeleria cristata			0.1				0.15
Lappula occidentalis				0.1	0.1	0.2	0.05
Lepidium virginicum							0.05
Oryzopsis hymenoides			0.1			0.3	
Phlox longifolia			0.1	0.1		0.1	
Salsola kali						0.1	
Stipa comata			0.1				
Stipa thurberiana				0.7		0.1	0.05
Sphaeralcea coccinea			0.1			0.1	
Sophia pinnata	0.3						0.05
Stanleya viridiflora						0.1	

* No significant difference between the three intensities of grazing.

PASTURE DESIGN OF GRAZING STUDY IN
BIG HORN BASIN



LEGEND

Unimproved roads . . . . .
Drainages . . . . . .
Halogeton plants. . . . .

FIGURE 1 Distribution of Halogeton within the Big Horn Halogeton Pasture, 1960.

The animals were weighed again upon removal from the pastures and a summary of these data is presented in Table 3. Gains were relatively high and hard to interpret. Two factors may have been largely responsible - (1) the animals may have been dehydrated upon their initial arrival and (2) no severe weather or deep snow accumulation occurred during the grazing period.

Studies of Mechanically treated Watersheds.

The North Fork Experimental Area (Figure 2) was established in 1960. Two pastures - one treated with waterspreaders which were seeded to Kochia scoparia, Agropyron cristatum, and A. elongatum, and the other, a non-treated native saltsage range - were used for a comparison of animal and vegetative responses.

Vegetative cover was estimated by permanent line-point transects, 250 feet long. Hits were recorded at one-foot intervals along the line. Forage production and utilization were estimated by clipping mechanically located plots, each 9.6 square feet in area. Within the treated pasture two strata were recognized and samples, individually -- (1) the dikes and related zones and (2) the relatively undisturbed native range lying between the dikes. The line-point transects were perpendicularly oriented to the dikes and production quadrats were mechanically located along similar lines.

Production of air-dry forage (Table 4) within the dike-area was estimated at 1529 pounds per acre, as compared to 218 pounds on the native range between dikes and 274 pounds on the check area. Forage on the dikes consisted largely of Agropyron cristatum, Agropyron elongatum and Kochia scoparia while on native range, Atriplex nuttallii existed in almost pure stands.

Vegetative cover and composition (Tables 5 and 6) were dominated by seeded species on the dikes and saltsage on native range between dikes and on the check area. These are poor criterion for estimating relative productivity of all species. Agropyron cristatum on the dikes, for example, contributes three times the ground cover of A. elongatum, but actual productivity is about the same due to different growth forms.

On June 27, 1960, 53 yearling steers were weighed individually and 18 were randomly assigned to the check area and 35 to the treated pasture. Forty-three days later, the animals were removed and individually weighed (Table 7).

The treated pasture was stocked at almost twice the rate per acre of the check area. Yet steers on the former each gained an average of almost 0.5 pound more each day than steers on the check area. At the end of the grazing season, animal gain per acre on the treated pasture was 3.4 times that of untreated range -- an advantage of about 1.7 pounds per acre.

Forage utilization data (Table 8) indicate moderate grazing of the seeded and native species. Animals within the treated pasture were reluctant to leave dike areas. Kochia scoparia received heavy use early in the grazing season, but as the season progressed, Agropyron cristatum and A. elongatum received increased use. Native saltsage range lying between the dikes was not grazed with utmost efficiency.

The animals were weighed again upon removal from the pastures and a summary of these data is presented in Table 3. Cattle were relatively high and hard to intermix. Two factors may have been largely responsible - (1) the animals may have been dehydrated upon their initial arrival and (2) no severe weather or deep snow accumulation occurred during the grazing period.

Studies of Biologically Treated Watersheds

The North Park Experimental Area (Figure 2) was established in 1956. Two pairs - one treated-plus watersheds which were seeded to Nordan crested wheatgrass, Agropyron cristatum, and A. trichophorum and the other, a non-seeded native rangeland - were used for a comparison of natural and vegetative responses.

Vegetative cover was estimated by permanent line-point transects, 250 feet long; lines were recorded at one-foot intervals along the line. Energy production and utilization were estimated by clipping randomly located plots, each 0.6 square foot in area. Within the fenced pasture two sites were recognized and sampled, individually -- (1) the dense and relict areas and (2) the relatively undisturbed native-range lying between the dikes. The line-point transects were perpendicularly oriented to the dikes and production quadrats were systematically located along similar lines.

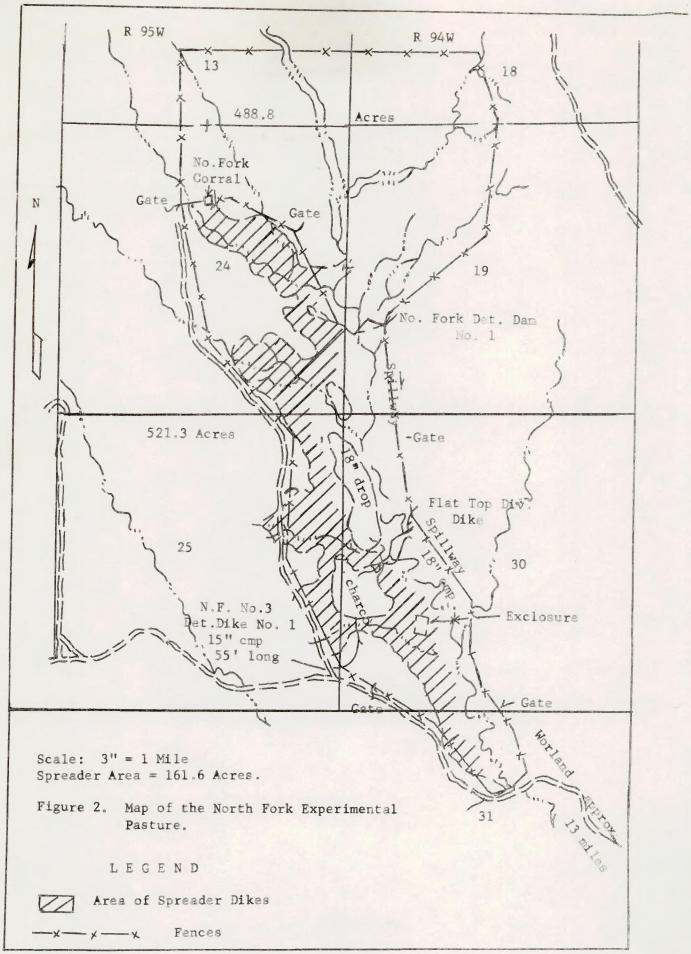
Production of key-ary forage (Table 4) within the dike-area was estimated at 1538 pounds per acre, as compared to 314 pounds on the native range between dikes and 374 pounds on the check area. Forage on the dike contained remnants of Agropyron cristatum, Agropyron trichophyrum and Bromus marginatus while on native range, Artemisia nova, Artemisia tridentata and Bromus marginatus were dominant.

Vegetative cover and composition (Tables 5 and 6) were dominated by annuals and biennials on the dikes and tallgrass on native range between dikes and on the check area. These are poor criterion for estimating relative productivity of all grassland. Basqueten cristatum on the dikes, for example, contributes three times the ground cover of A. trichophyrum, but actual productivity is about the same due to different growth forms.

On June 27, 1960, 33 yearling steers were weighed individually and 10 were randomly assigned to the check area and 23 to the treated pasture. Forty-three days later, the animals were removed and individually weighed (Table 7).

The treated pasture was stocked at almost twice the rate per acre of the check area. The steers on the former made gains on average of almost 0.3 pound more each day than steers on the check area. At the end of the 43 days grazing period, actual gain per acre on the treated pasture was 3.4 times that of unstocked range -- an advantage of about 1.7 pounds per acre.

Forage utilization data (Table 8) indicate moderate grazing of the seeded and native species. Animals within the treated pasture were fairly selective in their use of the area. Seeded species received heavy use early in the grazing season, but as the season progressed, Agropyron cristatum and A. trichophyrum received increased use. Native sagebrush range lying between the dikes was not grazed with almost sufficient



Scale: 3" = 1 Mile
Spreader Area = 161.6 Acres.

Figure 2. Map of the North Fork Experimental Pasture.

L E G E N D

Area of Spreader Dikes

Fences

TABLE 3. ANIMAL RESPONSE AND PERCENTAGE UTILIZATION OF SALTSAGE UNDER DIFFERENT INTENSITIES OF GRAZING.

	Light Use			Moderate Use			Heavy Use		
	1958	1959	1960	1958	1959	1960	1958	1959	1960
Average daily gain per animal	0.00	0.30	0.88	0.06	0.13	0.73	-0.07	-0.07	1.09
Mean		0.39			0.31			0.32	
Pounds of gain per acre	0.03	4.40	7.03	1.21	4.20	10.24	-0.90	-1.59	19.49
Mean		3.82			5.22			5.67	
Sheep days per acre	9.51	14.77	7.97	18.48	30.47	13.97	34.50	55.31	16.82
Mean		10.75			20.97			35.54	
Percentage utilization	6.50	31.30	11.60	36.00	54.00	39.47	54.60	86.60	74.10
Mean		16.47			43.16			71.77	

TABLE 3. ANIMAL RESPONSE AND FORCEWIDGE UTILIZATION OF SAN-TRACK UNDER DIFFERENT INTENSITIES OF GRAZING.

	Light Use			Moderate Use			Heavy Use		
	1938	1939	1940	1938	1939	1940	1938	1939	1940
Average daily gain per animal	0.00	0.30	0.88	0.06	0.13	0.73	-0.07	-0.07	1.00
Mean		0.39			0.31			0.32	
Pounds of gain per acre	0.03	4.40	7.03	1.21	4.20	10.34	-0.30	-1.30	19.49
Mean		3.67			5.25			5.67	
Sheep days per acre	9.31	16.77	7.07	18.68	30.47	13.97	34.50	73.31	16.82
Mean		10.73			20.97			35.54	
Percentage utilization	6.50	31.30	11.60	34.00	52.00	39.47	94.60	86.60	19.10
Mean		16.47			43.16			71.77	

TABLE 4. PRODUCTION OF FORAGE ON THE NORTH FORK EXPERIMENTAL AREA, 1960. (LBS. AIR-DRY FORAGE PER ACRE).

Species	Treated		Check
	Dike Area	Unaffected Area	
Agropyron cristatum	570.63		
Agropyron elongatum	579.34		
Agropyron spicatum	P*		P
Bouteloua gracilis			P
Munroa squarrosa		P	P
Oryzopsis hymenoides	P	P	P
Poa secunda		P	
Sitanion hystrix	121.97	P	
Sporobolus cryptandrus		P	P
Halogeton glomeratus	13.07	P	P
Kochia scoparia	182.95		
Misc. unidentified forbs	P	P	P
Artemisia spinescens		P	P
Atriplex nuttallii	60.98	217.8	274.4

* P = Present, but less than 5# per acre.

TABLE 4. PRODUCTION OF FORAGE ON THE NORTH FORK EXPERIMENTAL AREA, 1966. (LBS. AIR-DRY FORAGE PER ACRE).

Species	Grazed Plot Area	Protected Undisturbed Area	Change
Agropyron cristatum	510.83		
Agropyron dasystachum	579.39		
Agropyron spicatum	P*		?
Bouteloua gracilis			P
Danthonia unispicata		P	?
Oryzopsis hymenoides	P	P	?
Poa secunda		P	
Stipa comata	121.07	P	
Sporobolus cryptandrus		P	?
Halogeton glomeratus	13.07	P	?
Kochia scoparia	182.92		
Misc. undetermined forbs	P	P	?
Artemisia spinescens		P	?
Atriplex nuttallii	60.98	312.8	426.4

* P = Present, but less than 5# per acre.

TABLE 5. PERCENTAGE VEGETATIVE COVER, NORTH FORK EXPERIMENTAL AREA, 1960.

Species	Treated		Check
	Dike Area	Unaffected Area	
Agropyron cristatum	9		
Agropyron elongatum	3		
Bouteloua gracilis		P	P
Munroa squarrosa	P*		
Oryzopsis hymenoides	P	P	P
Poa secunda		P	
Sitanion hystrix	2		
Sporobolus cryptandrus	P	1	P
Stipa comata		P	
Halogeton glomeratus	1	4	1
Kochia scoparia	4		
Opuntia polyacantha		2	1
Xanthium echinatum	P		P
Misc. Unidentified forbs		P	
Artemisia spinescens		2	2
Artemisia tridentata	P		
Atriplex nuttallii	P	12	14
** Dead	5	1	3

* Less than 1 percent

** All species

TABLE 5. PERCENTAGE VEGETATIVE COVER, NORTH FORK EXPERIMENTAL AREA, 1960.

Species	Treated			
	Duff	Disk	Undisturbed	Check
Agropyron cristatum				
Agropyron dasystachyum				
Bouteloua gracilis				
Munroa squarrosa				
Oryzopsis hymenoides				
Poa secunda				
Stipa comata				
Sitanion hystrix				
Sporobolus cryptandrus				
Halogeton glomeratus				
Kochia scoparia				
Opuntia polyacantha				
Xanthium echinatum				
Misc. Unidentified forbs				
Artemisia spinescens				
Artemisia tridentata				
Atriplex nuttallii				
** Moss				

* Less than 1 percent

** All species

TABLE 6. PERCENTAGE VEGETATIVE COMPOSITION, NORTH FORK EXPERIMENTAL AREA, 1960.

Species	Dike	Treated	
	Dike area	Unaffected area	Check
Agropyron cristatum	35.9		
Agropyron elongatum	11.9		
Bouteloua gracilis			0.4
Munroa squarrosa	0.9		
Oryzopsis hymenoides		0.9	0.4
Poa secunda		0.2	
Sitanion hystrix	7.2		
Sporobolus cryptandrus	0.9	2.7	1.3
Stipa comata		0.2	
Halogeton glomeratus	4.9	16.0	4.3
Kochia scoparia	16.0		
Opuntia polyacantha		10.3	6.3
Xanthium echinatum	0.5		1.1
Misc. Unidentified forbs	0.8	1.8	
Artemisia spinescens		7.4	8.9
Artemisia tridentata	0.8		
Atriplex nuttallii	1.4	55.6	65.5
* Dead	18.7	5.2	11.7

* All species

TABLE 6.—PERCENTAGE VEGETATIVE COMPOSITION, MOUNT ROSE MEADOWS, NEV., 1960.

Species	Dike area	Dike area, fertilized	Check
Agrostis alba*	82.9		
Agrostis stolonifera	11.0		
Bromus marginatus			6.4
Bromus tectorum	0.9		
Chrysopsis hyssopifolia	0.9		52.4
Fox sedge	0.2		
Silene lyallii	2.1		
Spergularia rubra	0.9	2.7	1.3
Stipa comata		0.2	
Unidentified grasses	4.3	16.0	9.3
Wedgia scoparia	16.0		
Xanthium californicum	0.3	1.8	1.1
Zauschneria latifolia	0.9		
Artemisia tridentata	0.9		
Astragalus purshii	1.6	72.6	35.3
* Dead	18.7	2.2	11.7

* All species

TABLE 7. ANIMAL RESPONSE TO WATERSPREADING AND RESEEDING, NORTH FORK EXPERIMENTAL AREA, 1960.

	No. days Grazed	Steer Days Per Acre*	Average Daily Gain Per Head	Pounds of Gain Per acre
Treated area	43	2.95	0.82	2.41
Check	43	1.52	0.46	0.70

* Yearling steers

TABLE 8. PERCENTAGE UTILIZATION OF MAJOR SPECIES ON THE NORTH FORK EXPERIMENTAL AREA, 1960.

Species	Treated		Check
	Dike Area	Unaffected Area	
Agropyron cristatum	47.3	- -	- -
Agropyron elongatum	38.3	- -	- -
Sitanion hystrix	39.3	- -	- -
Kochia scoparia	33.4	- -	- -
Atriplex nuttallii	77.1	29.8	54.3

TABLE 7. ANIMAL RESPONSE TO WATERSPREADING AND RESEEDING, NORTH FORK EXPERIMENTAL AREA, 1950.

	No. days Grazed	Steer Days Gain Per Acre*	Average Daily Gain Per Head	Pounds of Gain Per Acre
Treated area	43	2.93	0.82	2.41
Check	43	1.52	0.86	0.70

* Yearling steers

TABLE 8. PERCENTAGE UTILIZATION OF MAJOR SPECIES ON THE NORTH FORK EXPERIMENTAL AREA, 1950.

Species	Treated		Check
	Dike Area	Untreated Area	
Agropyron cristatum	47.3	- -	- -
Agropyron elongatum	38.3	- -	- -
Stipa viridula	30.3	- -	- -
Koeleria cristata	33.4	- -	- -
Atriplex nuttallii	77.1	20.8	56.3

Exclosures and Related Studies

Edaphic, vegetative, climatic and biotic interrelationships were studied at a number of locations throughout the arid section of Wyoming. Vegetative analyses[1] are complete for a number of exclosures (Tables 9-20). Additional soil analyses have been made (Table 21) and precipitation data collected (Table 22).

Evaluation of Forage Plants [2]

The nutritional value of big sagebrush (Artemisia tridentata), Indian ricegrass (Oryzopsis hymenoides), meadow foxtail (Sitanion hystrix), and needle-and-thread grass (Stipa comata) is being studied with a "silk bag" technique. Two fistulated steers are available for the study.

Essentially, the method involves placing forage samples in nylon bags which are, in turn, placed in the rumen through the fistula. After a predetermined digestion period, the samples are removed, dried, and chemically analyzed. Results are compared with undigested material for an evaluation of digestability.

The study is in a preliminary stage and no data are currently available.

1/ Using the same number and type of quadrat for each exclosure as described previously for the each pasture in the intensity of grazing study.

2/ A cooperative project with the Animal Science Division, Wyoming Agricultural Experiment Station.

Rhizosphere and Related Studies

Simple, vegetative, climatic and biotic interrelationships were examined at a number of locations throughout the arid, western Wyoming. Vegetative comparisons are complete for a number of exclosures (Tables 20-20). Additional soil analyses have been made (Table 21) and precipitation data collected (Table 22).

Evaluation of Forage Plants 2/

The nutritional value of bluebunch wheatgrass (Agropyron spicatum), Indian ricegrass (Oryzopsis hymenoides), needle forage (Stipa comata), and needleandthread (Stipa comata) is being studied with a "bell jar" technique. The plucked plants are available for the study.

Essentially, the method involves placing forage samples in nylon bags which are, in turn, placed in the rumen through the fistula. After a predetermined digestion period, the samples are removed, dried, and chemically analyzed. Results are compared with undigested material for an evaluation of digestability.

The study is in a preliminary stage and no data are currently available.

1/ Using the same number and type of quadrat for each enclosure as described previously for the each pasture in the intensity of grazing study.

2/ A cooperative project with the Animal Science Division, Wyoming Agricultural Experiment Station.

TABLE 9. PERCENTAGE VEGETATIVE COVER WITHIN THE ANT HILL EXCLOSURE AND ADJACENT STUDY AREA, 1959.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Artemisia tridentata	10.9	11.7
Opuntia polyacantha	1.5	3.8
Grasses		
Agropyron spicatum	3.8	5.4
Bouteloua gracilis	7.6	7.6
Poa secunda	4.0	3.3
Stipa comata	0.3	- - -
Forbs		
Phlox spp.	0.2	0.8
Plantago purshii	2.3	1.2
Sphaeralcea coccinea	0.1	- - -

TABLE 10. PERCENTAGE VEGETATIVE COVER WITHIN THE HAPPY SPRINGS EXCLOSURE AND ADJACENT STUDY AREA, 1959.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Artemisia nova	1.9	3.1
Artemisia tridentata	8.9	10.9
Chrysothamnus viscidiflorus	- - -	0.1
Gutierrezia sarothrae	0.5	- - -
Opuntia polyacantha	- - -	0.3
Tetradymia canescens	0.2	0.3
Grasses and grass-likes		
Carex filifolia	5.6	8.2
Koeleria cristata	2.6	4.9
Stipa comata	28.6	21.9
Forbs		
Phlox spp.	0.6	- - -
Sphaeralcea coccinea	- - -	0.2

TABLE 9. PERCENTAGE VEGETATIVE COVER WITHIN THE ANT HILL ENCLOSURE AND ADJACENT STUDY AREA, 1979.

Species	Inside Enclosure	Outside Enclosure
Shrubs		
Artemisia tridentata	10.9	11.7
Opuntia polyacantha	1.5	3.8
Grasses		
Agropyron spicatum	3.8	5.4
Bouteloua gracilis	7.6	7.0
Poa secunda	2.0	3.2
Stipa comata	0.3	- - -
Forbs		
Phlox spp.	0.2	0.8
Plantago purshii	2.3	1.2
Sphaeralcea coccinea	0.1	- - -

TABLE 10. PERCENTAGE VEGETATIVE COVER WITHIN THE HARVY SPRINGS ENCLOSURE AND ADJACENT STUDY AREA, 1979.

Species	Inside Enclosure	Outside Enclosure
Shrubs		
Artemisia nova	1.9	2.1
Artemisia tridentata	8.9	10.9
Chrysothamnus viscidiflorus	- - -	0.1
Gutierrezia sarothrae	0.3	- - -
Opuntia polyacantha	- - -	0.3
Tetradymia canescens	0.2	0.2
Grasses and grass-likes		
Carex filifolia	3.6	8.2
Koeleria cristata	2.5	4.3
Stipa comata	28.5	21.9
Forbs		
Phlox spp.	0.5	- - -
Sphaeralcea coccinea	- - -	0.2

TABLE 11. PERCENT VEGETATIVE COVER WITHIN THE MCGRAW FLAT EXCLOSURE AND ADJACENT STUDY AREA, 1959.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Artemisia nova	0.2	---
Artemisia tridentata	28.0	26.9
Grasses		
Agropyron spicatum	14.3	15.6
Poa secunda	12.6	10.5
Forbs		
Phlox spp.	3.0	4.7

TABLE 12. PERCENT VEGETATIVE COVER WITHIN THE BLACK MOUNTAIN EXCLOSURE AND ADJACENT STUDY AREA, 1959.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Artemisia tridentata	1.6	0.6
Atriplex confertifolia	4.1	6.0
Atriplex nuttallii	0.5	0.4
Eurotia lanata	0.1	---
Gutierrezia sarothrae	---	0.6
Sarcobatus vermiculatus	---	1.0
Grasses		
Agropyron spicatum	8.7	3.5
Oryzopsis hymenoides	0.8	0.4
Stipa comata	0.2	0.3
Forbs		
Arabis hirsuta	0.6	0.3
Astragalus mollissims	0.3	0.1
Salsola kali	1.3	1.4

TABLE 11. PERCENT VEGETATIVE COVER WITHIN THE MCKAY FLAT EXCLOSURE AND ADJACENT STUDY AREA, 1955.

Species	Inside Enclosure	Outside Enclosure
Shrubs		
Artemisia nova	0.2	---
Artemisia tridentata	28.0	20.0
Grasses		
Agropyron spicatum	14.3	15.5
Poa secunda	12.0	10.3
Forbs		
Phlox spp.	3.0	4.7

TABLE 12. PERCENT VEGETATIVE COVER WITHIN THE BLACK MOUNTAIN ENCLOSURE AND ADJACENT STUDY AREA, 1955.

Species	Inside Enclosure	Outside Enclosure
Shrubs		
Artemisia tridentata	1.0	0.6
Atriplex confertifolia	5.1	6.1
Atriplex nuttallii	0.5	0.4
Gutierrezia linearis	0.1	---
Gutierrezia microcephala	---	0.8
Salicornia rubra/utahensis	---	1.0
Grasses		
Agropyron spicatum	8.7	2.5
Oryzopsis hymenoides	0.1	0.4
Stipa comata	0.2	0.3
Forbs		
Arabis hirsuta	0.6	0.3
Astragalus collinsianus	0.1	0.1
Salsola kali	1.3	1.0

TABLE 13. PERCENT VEGETATIVE COVER WITHIN THE CEDAR MOUNTAIN EXCLOSURE AND ADJACENT STUDY AREA, 1959.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Artemisia nova	10.6	1.7
Artemisia spinescens	2.5	3.1
Atriplex confertifolia	1.5	1.8
Atriplex nuttallii	0.1	0.1
Eurotia lanata	0.4	0.3
Cutierrezia sarothrae	1.0	1.1
Kochia americana	9.0	6.7
Opuntia polyacantha	0.7	---
Tetradymia canescens	0.1	0.9
Grasses		
Agropyron spicatum	0.7	---
Pordeum jubatum	0.1	0.2
Poa spp.	0.3	0.2
Forbs		
Phlox spp.	0.2	0.2

TABLE 14. PERCENT VEGETATIVE COVER WITHIN THE ANT STUDY EXCLOSURE AND ADJACENT STUDY AREA, 1959.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Artemisia tridentata	9.2	5.2
Atriplex nuttallii	---	0.2
Opuntia polyacantha	1.6	0.4
Grasses		
Bouteloua gracilis	8.8	9.8
Forbs		
Halogeton glomeratus	9.5	8.1
Plantago purshii	---	1.0
Salsola kali	---	0.2
Sphaeralcea coccinea	0.1	0.1

TABLE 13. PERCENT VEGETATIVE COVER WITHIN ONE CHAIN MONTANA EXCLOSURE AND ADJACENT STUDY AREA, 1979.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Artemisia nova	10.4	3.7
Artemisia spinescens	3.5	3.1
Atriplex confertifolia	1.5	1.7
Atriplex nuttallii	0.3	0.1
Eurotia lanata	2.4	0.3
Ceratoides arborea	1.0	1.1
Kochia americana	0.0	6.7
Opuntia polyacantha	0.7	---
Tetradymia canescens	0.1	0.9
Grasses		
Agropyron spicatum	7.7	---
Bromus tectorum	0.1	0.1
Poa spp.	0.3	0.2
Forbs		
Phlox spp.	1.2	0.2

TABLE 14. PERCENT VEGETATION COVER WITHIN THE ONE CHAIN EXCLOSURE AND ADJACENT STUDY AREA, 1979.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Artemisia tridentata	0.2	1.2
Atriplex nuttallii	---	0.2
Opuntia polyacantha	1.8	0.6
Grasses		
Sanguisorba graecilis	6.5	2.8
Forbs		
Halogeton glomeratus	9.5	1.1
Plantago purshii	---	1.0
Salsola kali	---	0.2
Sphaeralcea coccinea	0.1	0.1

TABLE 15. PERCENT VEGETATIVE COVER WITHIN THE BOYSEN RESERVOIR EXCLOSURE AND ADJACENT STUDY AREA, 1959.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Opuntia polyacantha	0.2	0.3
Grasses		
Bouteloua gracilis	12.7	10.6
Forbs		
Salsola kali	- - -	0.1
Sphaeralcea coccinea	0.7	0.5

TABLE 16. PERCENT VEGETATIVE COVER WITHIN THE BUFFALO CREEK EXCLOSURE AND ADJACENT STUDY AREA, 1959.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Artemisia tridentata	1.3	4.3
Eurotia lanata	- - -	0.1
Opuntia polyacantha	1.0	1.1
Grasses		
Agropyron dasystachyum	3.0	6.0
Agropyron spicatum	17.8	9.9
Bouteloua gracilis	2.4	4.0
Forbs		
Lepidium densiflorum	0.1	- - -
Phlox spp.	- - -	1.1
Plantago purshii	0.3	0.1
Sophia pinnata	0.7	0.5
Sphaeralcea coccinea	0.5	0.3

TABLE 15. PERCENT VEGETATIVE COVER WITHIN THE BOYSEN RESERVOIR EXCLOSURE AND ADJACENT STUDY AREA, 1979.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Chrysothamnus viscidiflorus	0.2	0.3
Grasses		
Bromus tectorum	12.7	10.5
Forbs:		
Salsola kali	- - -	0.1
Sphaeralcea coccinea	0.7	0.3

TABLE 17. PERCENTAGE VEGETATIVE COVER WITHIN THE BURNT WAGON EXCLOSURE AND ADJACENT STUDY AREA, 1959.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Atriplex nuttallii	3.5	3.8
Opuntia polyacantha	- - -	0.4
Forbs		
Allium textile	0.3	0.3
Annual *	3.7	1.1
Perennial **	7.6	6.6

* Unidentified annual forb other than Halogeton glomeratus.
** Unidentified perennial forb of the Umbelliferae.

TABLE 18. PERCENTAGE VEGETATIVE COVER WITHIN THE DEMER DOME EXCLOSURE AND ADJACENT STUDY AREA, 1959.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Artemisia tridentata	7.8	5.9
Opuntia polyacantha	1.7	3.6
Grasses		
Agropyron spicatum	2.4	0.1
Bouteloua gracilis	5.7	8.6
Sitanion hystrix	0.4	- - -
Forbs		
Lepidium densiflorum	0.8	1.8
Plantago purshii	3.7	4.0
Salsola kali	1.5	2.4
Perennial *	4.8	3.9

* Unidentified perennial forb.

TABLE 17. PERCENTAGE VEGETATIVE COVER WITHIN THE MESIC UNION EXCLUSURE AND ADJACENT GRAZED STUDY AREA, 1979.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Atriplex nuttallii	3.2	3.8
Opuntia polyacantha	- - -	0.4
Forbs		
Allium textile	0.3	0.1
Annual *	3.7	1.1
Perennial **	7.8	6.8

* Unidentified annual forb other than Halogeton glomeratus.
** Unidentified perennial forb of the Dicotiledonae.

TABLE 18. PERCENTAGE VEGETATIVE COVER WITHIN THE DENSE DUFF EXCLOSURE AND ADJACENT GRAZED STUDY AREA, 1979.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Artemisia tridentata	7.8	5.8
Opuntia polyacantha	1.7	3.1
Grasses		
Agropyron spicatum	3.6	0.1
Bouteloua gracilis	5.7	8.5
Stipa hymenoides	0.4	- - -
Forbs		
Lepidium densiflorum	0.8	1.8
Plantago purshii	3.7	0.9
Salsola kali	1.3	2.4
Perennial *	4.8	3.9

* Unidentified perennial forb.

TABLE 19. PERCENTAGE VEGETATIVE COVER WITHIN THE DUTCH NICK EXCLOSURE AND ADJACENT STUDY AREA, 1959.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Artemisia tridentata	0.3	---
Atriplex nuttallii	---	0.1
Eurotia lanata	---	0.1
Opuntia polyacantha	5.4	7.5
Grasses		
Bouteloua gracilis	24.4	22.7
Forbs		
Lappula or Crypthantha spp.	4.9	1.6
Lepidium densiflorum	8.2	1.2
Plantago purshii	0.7	3.6

TABLE 20. PERCENTAGE VEGETATIVE COVER WITHIN THE WEST PASTURE EXCLOSURE AND ADJACENT STUDY AREA, 1959.

Species	Inside Exclosure	Outside Exclosure
Shrubs		
Artemisia spinescens	1.5	2.0
Artemisia tridentata	---	1.3
Atriplex nuttallii	11.1	7.5
Opuntia polyacantha	9.0	1.8
Grasses		
Bouteloua gracilis	---	0.4
Oryzopsis hymenoides	3.5	0.9
Poa spp.	1.9	0.1
Sitanion hystrix	---	0.2
Forbs		
Allium textile	---	0.1
Perennial*	---	---

* Perennial forbs of the Umbelliferae.

TABLE 19. PERCENTAGE AERIAL COVER WITHIN AND OUTSIDE MICROENCLOSURE AND ADJACENT STUDY AREA, 1979.

Species	Inside Enclosure	Outside Enclosure
Shrubs:		
Artemisia tridentata	0.3	---
Atriplex nuttallii	---	0.1
Eurotia lanata	---	0.1
Opuntia polyacantha	3.4	7.3
Grasses		
Bouteloua gracilis	24.4	22.7
Forbs		
Lappula or Cryptantha spp.	6.3	1.6
Lesquerella ovalifolia	1.4	1.2
Plantago purshii	0.7	3.6

TABLE 20. PERCENTAGE AERIAL COVER WITHIN AND OUTSIDE MICROENCLOSURE AND ADJACENT STUDY AREA, 1979.

Species	Inside Enclosure	Outside Enclosure
Shrubs:		
Artemisia cana	1.3	5.0
Artemisia tridentata	---	1.2
Atriplex nuttallii	11.2	2.2
Opuntia polyacantha	0.8	1.6
Grasses		
Bouteloua gracilis	---	8.4
Oryzopsis hymenoides	3.2	2.0
Poa spp.	1.8	0.1
Stipa comata	---	0.2
Forbs		
Allium textile	---	0.1
Perennial*	---	---

* Perennial forbs of the Umbelliferae.

TABLE 21. SOIL ANALYSES FROM VARIOUS EXCLOSURE SITES, 1959.

Exclosure and Soil Depth in Inches	Soil Texture	Phosphate (lbs/acre)	Organic matter (%)	pH		Soluble Salts E.C. x 10^{-3}	Cation exchange capacity (meg./100gr.)	Exchangeable sodium + soluble sodium (meg/100gr.)	Soluble sodium (meg./100 gr.)
				Paste	Dilution				
Red Wash No. 1									
0 - 8	Clay	53	1.2	8.1	9.0	1.7	29.0	7.70	0.52
8 - 18	Silt loam	46	0.9	7.9	8.2	4.5	39.6	11.10	1.61
18 - 36	Clay	33	1.4	8.0	9.0	4.4	32.8	12.15	0.38
36 - 48	Loam	35	0.5	8.3	9.1	5.0	14.8	6.75	0.05
Red Wash No. 2									
1 - 6	Sandy loam	33	1.7	7.7	8.3	1.2	15.6	0.65	0.10
6 - 24	Silt loam	12	1.1	8.3	9.3	1.1	25.4	6.00	0.59
24 - 36	Silty clay loam	9	0.9	8.3	9.4	4.4	20.4	12.50	1.36
Red Wash No. 3									
0 - 6	Sandy loam	35	1.5	7.9	8.3	0.8	---	0.75	---
6 - 13	Sandy loam	21	1.3	8.0	8.6	4.5	15.2	2.45	1.03
13 - 36	Sandy loam	23	0.7	8.2	9.0	5.0	---	3.85	---
36 - 48	Sandy loam	23	0.8	7.8	8.1	9.5	25.0	3.35	0.32
Ant Study									
0 - 4	Loam	50	1.5	7.8	8.1	0.9	16.6	0.60	0.10
4 - 21	Silt	39	1.3	7.6	7.6	3.4	16.2	1.10	0.25
21 - 38	Sandy loam	32	0.8	7.6	7.9	3.2	12.6	1.53	0.17
Little Robber Dike									
0 - 6	Loam	39	1.1	7.9	8.2	0.7	22.6	1.25	0.14
6 - 18	Clay loam	12	3.1	8.0	8.5	2.0	16.6	3.05	0.69
18 - 36	Silty clay loam	20	1.1	7.8	8.3	3.9	18.0	3.90	1.11
36 - 48	Clay	16	0.5	7.9	8.4	3.3	26.2	4.60	1.04

* Continued next page.

TABLE 21. SOIL ANALYSES FROM VARIOUS EXCLOSURE SITES, 1959.

Exclosure and Soil Depth in Inches	Soil Texture	Phosphate (lbs/acre)	Organic matter (%)	pH Paste	pH Dilution	Soluble Salts E.C. x 10^{-3}	Cation exchange capacity (meq./100gr.)	Exchangeable Soluble sodium + sodium (meq./100 gr.)	Soluble sodium (meq./100gr.)
Red Wash No. 1									
0 - 8	Clay	51	1.2	6.1	5.0	1.7	29.0	7.70	0.52
8 - 18	Silt loam	46	0.9	7.9	6.2	4.3	29.6	11.10	1.81
18 - 36	Clay	33	1.4	8.0	6.4	3.4	32.4	12.15	0.36
36 - 48	loam	35	0.5	8.3	9.1	5.0	16.8	8.75	0.05
Red Wash No. 2									
1 - 6	Sandy loam	33	1.7	7.7	6.3	1.2	15.6	6.65	0.10
6 - 24	Silt loam	12	1.1	8.3	9.3	1.1	25.6	8.00	0.39
24 - 36	Silty clay loam	9	0.5	8.3	9.4	3.4	20.4	12.50	1.36
Red Wash No. 3									
0 - 6	Sandy loam	35	1.5	7.9	8.5	0.8	---	0.75	---
6 - 13	Sandy loam	21	1.3	8.0	8.6	6.5	15.2	2.45	1.03
13 - 36	Sandy loam	23	0.7	8.2	9.0	5.0	---	3.65	---
36 - 42	Sandy loam	23	0.6	7.6	9.1	9.3	25.0	3.35	0.32
Ant Study									
0 - 4	loam	50	1.5	7.8	8.1	0.9	16.6	0.80	0.10
4 - 21	Silt	39	1.1	7.8	7.8	3.4	18.2	1.10	0.25
21 - 38	Sandy loam	22	0.8	7.6	7.9	3.2	12.0	1.35	0.17
Kitty Rubber Dike									
0 - 6	loam	39	1.1	7.9	8.2	0.7	22.6	1.25	0.14
6 - 16	Clay loam	12	3.1	8.0	8.5	2.0	16.6	3.05	0.09
16 - 36	Silty clay loam	20	1.1	7.8	8.3	3.9	18.0	3.90	1.11
36 - 46	Clay	15	0.3	7.9	8.4	3.3	20.2	6.60	1.04

* Continued next page.

Table 21. Continued.

Exclosure and Soil Depth in Inches	Soil Texture	Phosphate (lbs/acre)	Organic matter (5)	pH		Soluble Salts E.C. x 10^{-3}	Cation exchange capacity (meg./100 gr.)	Exchangeable sodium + soluble sodium (meg/100 gr.)	Soluble sodium (meg./ 100 gr.)
				Paste	Dilution				
Boar's Tusk									
0 - 35	Loam	46	2.5	7.5	8.0	1.7	16.4	0.90	0.23
35 - 45	Loam	10	0.7	8.1	8.5	1.2	14.4	1.65	0.28
Halogeton #1									
0 - 5		---	---	---	---	---	16.8	2.30	0.35
5 - 15		---	---	---	---	---	20.6	3.90	0.89
15 - 48		---	---	---	---	---	14.0	3.50	1.02
Halogeton # 2									
0 - 4		---	---	---	---	---	18.6	2.90	1.09
4 - 33		---	---	---	---	---	16.6	5.30	1.42
Halogeton #3									
0 - 4		---	---	---	---	---	15.4	1.60	0.27
4 - 36		---	---	---	---	---	22.2	3.65	0.92
36 - 48		---	---	---	---	---	11.0	2.90	1.11

Table 21. Continued.

Exposure and Soil Depth in Inches	Soil Texture	Phosphate (lbs/acre)	Organic matter (%)	pH Paste	pH Dilution	Soluble Salts E.C. x 10^{-3}	Cation exchange capacity (meq./100 gr.)	Exchangeable Soluble sodium + sodium (meq./100 gr.)	Exchangeable Soluble sodium (meq./100 gr.)
Starr's Dusk									
0 - 32	Loam	46	2.5	7.5	6.0	1.7	16.4	0.80	0.23
32 - 63	Loam	10	0.7	8.1	6.5	1.2	19.4	1.65	0.26
Halegeton #1									
0 - 3	---	---	---	---	---	---	16.8	2.30	0.35
3 - 15	---	---	---	---	---	---	24.8	3.90	0.39
15 - 62	---	---	---	---	---	---	18.0	3.50	1.02
Halegeton #2									
0 - 4	---	---	---	---	---	---	18.6	2.80	1.09
4 - 33	---	---	---	---	---	---	16.8	3.30	1.82
Halegeton #3									
0 - 4	---	---	---	---	---	---	15.4	1.80	0.37
4 - 36	---	---	---	---	---	---	22.2	3.65	0.82
36 - 48	---	---	---	---	---	---	17.0	2.80	1.11

TABLE 22. PRECIPITATION OF EXCLOSURE SITES.

Exclosure	County	Elevation	Dates	Inches of Precipitation
Ant Study	Washakie	4,879	4/29/59 - 11/10/59	4.29
			11/10/59 - 10/11/60	5.69
Farson	Sweetwater	6,590	7/28/60 - 10/11/60	1.81
Dutch Wick Flat	Washakie	4,475	4/30/59 - 6/12/59	1.70
			6/12/59 - 10/11/60	5.41
Ant Hill	Fremont	5,350	5/ 8/59 - 11/10/59	3.30
			11/10/59 - 10/11/60	5.80
Buffalo Creek	Washakie	5,120	5/13/59 - 8/ 4/59	3.50
			4/26/60 - 10/11/60	4.70
Demer Dome	Washakie	4,680	5/13/59 - 11/ 9/59	4.00
			11/ 9/59 - 10/11/60	7.16
North Government Draw	Fremont	6,080	5/ 8/59 - 8/21/59	2.43
			8/21/59 - 10/11/60	6.25
Boysen Reservoir	Fremont	4,825	7/ 7/59 - 11/10/59	0.92
			11/10/59 - 10/11/60	2.97
Hot Springs	Fremont	6,565	8/17/59 - 11/11/59	2.09
			11/11/59 - 10/11/60	4.82
Horse Creek	Big Horn	5,460	4/29/59 - 8/ 7/59	2.25
			8/ 7/59 - 4/22/60	----
			4/22/60 - 10/11/60	5.48
West Pasture	Washakie	4,579	4/29/59 - 6/11/59	0.90
			4/ 4/60 - 10/11/60	3.45

*Table continued next page

TABLE 32. PREDICTIVE DOPPLER RADAR.

Department	County	Direction	Time	Degree of Precipitation
Art Study	Manhattan	4,870	07/09/59 - 11/01/59 11/02/59 - 11/21/60	5.69
Ranson	Swartzwater	5,980	12/01/60 - 10/21/61	1.11
Beach Art Prof.	Dandridge	4,975	10/22/61 - 04/21/62 04/22/62 - 06/21/62	1.71 5.01
Mrs Bill	Zeppelin	5,450	06/22/62 - 11/01/62 11/02/62 - 11/21/63	5.11
Bayfield Creek	Tanglefield	5,120	11/22/63 - 01/21/64 01/22/64 - 10/12/65	3.89 4.30
Dance Dept.	Wellington	4,680	10/13/65 - 11/21/65 11/22/65 - 10/12/66	4.00 7.18
Speech Department Dept.	Pressent	6,005	10/13/66 - 11/21/66 11/22/66 - 10/12/67	2.09 2.13
Beverly Beaverett	Element	4,055	10/13/67 - 11/21/67 11/22/67 - 10/12/68	0.83 2.57
Mat Petition	Pressent	6,555	10/13/68 - 11/21/68 11/22/68 - 10/12/69	1.09 6.38
Beverly Church	Mat Beach	3,600	10/13/69 - 01/21/70 01/22/70 - 04/21/70	2.23 ----
Mrs Quarter	Beachcomber	4,370	04/22/70 - 07/21/70 07/22/70 - 10/12/70	5.44 0.30

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TABLE 22. Continued.

Exclosure	County	Elevation	Dates	Inches of Precipitation
15-Mile Study Pasture	Washakie	4,510	4/14/60 - 10/11/60	4.41
McGraw Flat	Fremont	6,750	5/ 9/59-- 11/11/59	0.60
			4/ 6/60 - 10/11/60	5.26
South Government Draw	Fremont		5/10/60 - 10/11/60	3.68
Burnt Wagon	Washakie	4,250	4/29/59 - 7/29/59	1.40
			4/ 4/60 - 10/11/60	3.21
Cedar Mountain	Sweetwater	6,950	4/ 5/60 - 10/11/60	2.85
Radio Tower	Sweetwater	6,800	5/10/60 --10/11/60	2.67
Black Mountain	Sweetwater	6,170	4/ 5/60 - 10/11/60	2.57
Sheep Springs	Big Horn	6,795	7/13/60 - 10/11/60	4.02
Halogeton Pastures	Big Horn	4,813	4/28/59 - 11/ 2/59	5.62
			11/ 2/59 - 10/11/60	2.72
Red Wash No. 2	Sweetwater	6,375	8/20/60 - 10/11/60	1.23
Red Wash No. 3	Carbon	6,550	8/20/60 - 10/11/60	0.83
Little Robber No. 5	Carbon	5,965	8/20/60 - 10/11/60	0.75
Boar's Tusk	Sweetwater	6,735	5/10/60 - 10/11/60	3.00

Table 22. Continued.

Description	County	Elevation	Dates	Index of Precipitation
15-Mile Stock Pasture	Hamilton	4,510	6/1/60 - 10/1/60	4.43
McClure Flat	Fremont	6,120	5/ 6/60- 10/1/60	0.80
			6/ 1/60 - 10/1/60	2.58
South Cooperman Draw	Fremont		6/1/60 - 10/1/60	1.48
Burnt Wagon	Wasatch	4,250	6/29/60 - 10/29/60	3.31
			6/ 1/60 - 10/1/60	
Cedar Mountain	Duchesne	6,900	6/ 1/60 - 10/1/60	2.85
Willis Creek	Sanpete	6,100	5/31/60 -10/31/60	2.07
Brush Mountain	Sheeprocker	6,120	6/ 1/60 - 10/1/60	2.57
Sheep Bridge	Big Horn	6,295	7/13/60 - 10/1/60	4.02
Hydrographer Pasture	Big Horn	6,213	6/29/60 - 10/1/60	5.62
			11/ 2/60 - 10/1/60	2.72
Bad Wash No. 2	Duchesne	6,320	6/29/60 - 10/1/60	1.23
Bad Wash No. 3	Carbon	6,520	6/29/60 - 10/1/60	0.83
Little Bobber No. 5	Carbon	5,985	6/29/60 - 10/1/60	0.75
Boar's Tusk	Sweetwater	6,735	5/31/60 - 10/1/60	3.00

EFFECT OF BIG-SAGEBRUSH CONTROL UPON THE COVER AND PRODUCTION OF NATIVE FORAGE SPECIES, SOIL-MOISTURE PERCENTAGE, AND SNOW COVER

by

Harold P. Alley[1/]

The experimental area located in the Red Desert and methods of sampling vegetation, snow cover, and soil moisture were described in the 1958 Bureau of Land Management Annual report, Chapter 3, of Mimeograph Circular 114, and the annual report for 1959.

Vegetative Composition

The effect of sagebrush control on the foliage cover one, two, and three years after chemical treatment is presented in Table 1.

The foliage cover of the common native grasses has shown a steady increase during the past three years. The original survey (1957) showed a cover of grasses representing 14.1 percent of the total. The 1960 vegetative survey shows the native grass cover as representing 47.8 percent of the total ground cover -- a three-fold increase in three years.

Thickspike wheatgrass (Agropyron dasystachyum) and prairie junegrass (Koeleria cristata) have shown the greatest response over the three-year period; however, Indian ricegrass (Oryzopsis hymenoides), and bottlebush squirreltail (Sitanion hystrix) showed the largest increase in 1960.

The foliage cover of semi-shrubs and forbs increased in 1960 (Table 1). This increase was mainly in Low Douglas rabbitbrush (Chrysothamnus pumilus) and smooth Hoods phlox (Phlox glabrata). The increase of rabbitbrush will be watched closely in future years as this could be of considerable concern where sagebrush and rabbitbrush are growing together.

Production and Utilization

The production of native grasses increased approximately 100 percent one year after initial treatment (1958). The area had been extensively grazed and exclosures had not been constructed by the 1959 season, therefore no production was measured in 1959. The 1960 production of native grasses in the sprayed areas had increased over 500 percent over the unsprayed areas. Clipping data show the chemically controlled areas had produced, on an average, 632 pounds of air-dry forage per acre as compared to 118 pounds on the unsprayed areas.

An exclosure was constructed by the Bureau of Land Management in the fall of 1959. The area outside the exclosure had not been grazed to the extent that utilization percentage could be determined for the 1960 season.

1/ Assistant Professor in Plant Science, Wyoming Agricultural Experiment Station.

EFFECT OF SAGEBRUSH CONTROL UPON THE COVER AND PRODUCTION OF NATIVE FORAGE GRASSES, SOUTH-MOUNTAIN PASTURE, ADA COUNTY, IDAHO

by

Harold F. Alley[1/]

The experimental area located in the Red Desert and methods of sampling vegetation, plus cover, and soil moisture were described in the 1959 Bureau of Land Management Annual report, Chapter 7, of Misc. Publ. 17, Agricultural Experiment Station, Moscow, Idaho.

Vegetative Composition

The effect of sagebrush control on the foliage cover one, two, and three years after treatment is presented in Table 1.

The foliage cover of the common native grasses has shown a steady increase during the past three years. The original survey (1957) showed a cover of grasses representing 19.1 percent of the total. The 1960 vegetative survey showed 24.4 native grass cover as representing 27.8 percent of the total ground cover -- a three-fold increase in three years.

Thickspike wheatgrass (Agropyron dasystachyum) and prairie junegrass (Koeleria cristata) have shown the greatest response with the three-year period. However, Indian ricegrass (Oryzopsis hymenoides), and bottlebrush squirreltail (Sitanion hystrix) showed the largest increase in 1960.

The foliage cover of annual-shrubs and forbs increased in 1960 (Table 1). This increase was mainly in low density cushionbush (Chrysothamnus viscidiflorus) and spiny hopsage (Grayia spinosa). The increase of [illegible] was slight.

[illegible] the growing [illegible].

Production and Utilization

The production of native grasses increased approximately 100 percent one year after initial treatment (1958). The area has been extensively grazed and [illegible] areas had not been constructed by the 1959 season, therefore no production was measured in 1959. The 1960 production of native grasses in the sagebrush areas had increased over 200 percent over the unsprayed areas. Clipping data show the chemically controlled areas had produced, on an average, 833 pounds of air-dry forage per acre as compared to 119 pounds on the unsprayed areas.

An exclosure was constructed by the Bureau of Land Management in the fall of 1959. The area outside the exclosure had not been grazed to the extent that utilization percentage could be determined for the 1960 season.

1/ Assistant Professor in Plant Science, Wyoming Agricultural Experiment Station.

Soil-Moisture Studies

Soil-moisture studied were started in 1958 and have been continued over the last two years. Data, presenting the average percentage moisture for months and years, are presented in Table 2. The chemically treated areas retained a higher percentage of moisture at all depths of sampling in 1958. The largest difference was at the 18- to 19-inch level on the July sampling date.

Studied made in 1959, two years after treatment, show that the controlled area contained 26.6 percent more moisture at the 12- to 13-inch depth and 34.7 percent more moisture at the 18- to 19-inch depth than the uncontrolled sagebrush area on the June 8 sampling date. No appreciable difference was noted at any depth of sampling in July or September.

The 1960 soil-moisture data were much reversed compared to that of previous years. Only at the 18- to 19-inch soil depth was there more moisture present in the controlled areas than in the uncontrolled areas. This reflected the difference shown at the early date of sampling (April 1960).

The average percentage of moisture for the controlled and uncontrolled areas at three soil depths for the three years is Shown in Table 3. Even with the reversed trends in 1960, there was, as an average of the three years, more moisture in the soils on the sprayed areas, especially at the 18- to 19-inch depth. The controlled area averaged 24.6 percent more soil moisture than the uncontrolled at this depth. The increased grass cover and increased growth of the grasses on the controlled area, along with the drought conditions of 1960, may have caused the reversal of soil-moisture data as compared with the previous two years.

Bouyoucos block readings (Table 4), over the three-year period, show that the atmospheric tension was consistently higher on the unsprayed areas in the months that readings were taken. The correlating of the bouyoucos block readings with the actual soil-moisture measurements clearly shows the droughty conditions which prevailed in 1960. In all cases, the tension approached 15 atmospheres at all depths on both the controlled and uncontrolled areas as early as July. The 1959 readings in the uncontrolled areas approached the 15 atmospheres level, but the controlled area readings did not approach this figure. With 15 atmospheres tension being recognized as the "permanent wilting point" of most plants, these data show that the areas were dry early in the 1960 growing season.

Snow Cover

Snow-cover and snow-moisture-content measurements were made in February and March, 1960. Measurable snow was not present until February and the snow had melted by April.

The February 1960, data showed that the sprayed areas were covered with an average snow depth of 10.6 inches containing 2.5 inches of moisture and the unsprayed buffer strips with an average of 11.0 inches of snow, containing 2.6 inches of moisture. In March 1960, sprayed areas were covered with an average of 11.9 inches of snow, containing 3.8 inches of moisture as compared to the unsprayed buffer strips which were covered with an average of 10.4 inches of snow containing 3.4 inches of moisture.

Soil-Moisture Studies

Soil-moisture studies were started in 1938 and have been continued over the last two years. Data, presenting the average percentage moisture for months and years, are presented in Table 2. The chemically treated areas contained a higher percentage of moisture at all depths of sampling in 1938. The largest difference was at the 18- to 19-inch level on the July sampling date.

Studied made in 1939, two years after treatment, show that the controlled area contained 26.6 percent more moisture at the 12- to 13-inch depth and 39.1 percent more moisture at the 18- to 19-inch depth than the uncontrolled sagebrush area on the June 8 sampling date. No appreciable difference was noted at any depth of sampling in July or September.

The 1940 soil-moisture data were much reversed compared to that of previous years. Only at the 18- to 19-inch soil depth was there more moisture present in the controlled areas than in the uncontrolled areas. This reflected the difference shown at the early date of sampling (April 1940).

The average percentage of moisture for the controlled and uncontrolled areas at three soil depths for the three years is shown in Table 3. Even with the reversed trends in 1940, there was, as an average of the three years, more moisture in the soils on the sprayed areas, especially at the 18- to 19-inch depth. The controlled area averaged 24.8 percent more soil moisture than the uncontrolled at this depth. The increased grass cover and increased growth of the grasses on the controlled area, along with the drought conditions of 1940, may have caused the reversal of soil-moisture data as compared with the previous two years.

Nonviscous block readings (Table 4), over the three-year period, show that the atmospheric tension was consistently higher on the sprayed areas in the months that readings were taken. The corresponding of the nonviscous block readings with the actual soil-moisture measurements clearly shows the drought conditions which prevailed in 1940. In all cases, the tension approached 15 atmospheres at all depths on both the controlled and uncontrolled areas as early as July. The 1939 readings in the uncontrolled areas approached the 15 atmosphere level, but the controlled area readings did not approach this figure. With 15 atmosphere tension being recognized as the "permanent wilting point" of most plants, these data show that the areas were dry early in the 1940 growing season.

Snow Cover

Snow-cover and snow-moisture-content measurements were made in February and March, 1940. Measurable snow was not present until February and the snow had melted by April.

The February 1940, data showed that the sprayed areas were covered with an average snow depth of 10.8 inches containing 2.3 inches of moisture and the unsprayed buffer strips with an average of 11.0 inches of snow, containing 2.8 inches of moisture. In March 1940, sprayed areas were covered with an average of 11.8 inches of snow, containing 3.8 inches of moisture as compared to the unsprayed buffer strips which were covered with an average of 10.4 inches of snow containing 3.4 inches of moisture.

Considerable drifting occurred in the area of tall sagebrush clumps and immediately east of the ridge running through the plots. Snow was measured across all areas except where extensive drifting occurred.

TABLE 1. FOLIAGE COVER OF BIG-SAGEBRUSH/CRASS-TYPE RANGELAND IN THE DIVIDE GRAZING DISTRICT OF SOUTHERN WYOMING, ONE, TWO, AND THREE YEARS AFTER CHEMICAL SAGEBRUSH CONTROL. 1/

Species	Foliage Cover 2/			
	1957	1958	1959	1960
Shrubs				
Big sagebrush (Artemisia tridentata)	25.4	16.5	11.6	17.7
Semi-Shrubs				
Slender eriogonum (Eriogonum microthecum)	0.6	0.5	1.0	1.0
Low Douglas rabbitbrush (Chrysothamnus pumilus)	2.4	1.5	3.3	7.0
TOTAL	3.0	2.0	4.3	8.0
Forbs				
Smooth Hoods Phlox (Phlox glabrata)	2.9	1.0	1.0	2.5
Stemless goldenweed (Aplopappus acaulis)	0.6	0.1	- - -	0.3
Prickly pear (Opuntia polyacanthia)	0.3	0.1	0.3	0.9
Other species 3/	0.5	0.7	0.6	0.4
TOTAL	4.3	1.9	1.9	4.1
Grasses				
Thickspike wheatgrass (Agropyron dasystachyum)	5.4	12.5	23.8	23.2
Pr. junegrass (Koeleria cristata)	1.2	13.4	9.6	9.2
Needlegrass (Stipa comata and lettermani)	1.5	1.5	1.9	1.3
Indian ricegrass (Oryzopsis hymenoides)	0.8	1.1	0.9	4.6
Sandberg bluegrass (Poa secunda)	4.0	1.7	2.3	2.7
Bottlebush squirreltail (Sitanion hystrix)	1.2	3.0	4.2	6.8
TOTAL	14.1	33.2	42.7	47.8
Bare Area	53.2	46.4	39.5	22.4

1/ Experimental area located on the Divide Grazing District, 26 miles west of Rawlins, Wyoming, and 2 miles south on Highway 789. The 1957 vegetative survey was taken the same year as chemical application. Surveys have been made in 1958, 1959, and 1960 to determine the effect of chemical control of sagebrush upon the vegetative cover.

2/ Data are an average of 6,000 points taken on 50 acres by the point-transect method and indicate vegetation as observed from directly above. The 1958-59-60 data represent the average vegetative cover for all degrees of sagebrush control.

3/ Other species: Bush birdbeak (Cordylanthus ramosus) and a species of clover which contributed less than 0.2 percent abundance.

Considerable drifting occurred in the area of tall sagebrush ridges and immediately east of the ridge running through the plots. Snow was measured across all areas except where excessive drifting occurred.

TABLE 1. FOLIAGE COVER OF BIG-SAGEBRUSH/GRASS-TYPE RANGELAND IN THE BIGHORN BASIN DISTRICT OF SOUTHERN WYOMING, 1972, 1973, AND THREE YEARS AFTER CHEMICAL BROWNSHIP CONTROL. 1/

Species	Foliage Cover 2/			
	1972	1973	1974	1976
Shrubs				
Big sagebrush (Artemisia tridentata)	23.4	20.3	11.6	17.7
Semi-shrubs				
Slender eriogonum (Eriogonum microthecum)	0.6	0.5	1.0	1.0
Low Douglas rabbitbrush (Chrysothamnus pumilus)	3.4	1.5	1.4	4.0
TOTAL -	4.0	2.0	2.4	5.0
Forbs				
Smooth Woods Phlox (Phlox alyssifolia)	2.6	1.0	1.0	2.3
Stemless goldenweed (Haplopappus acaulis)	0.5	0.1	- - -	0.3
Prickly pear (Opuntia polyacantha)	0.2	0.1	0.3	0.4
Other species 3/	0.5	0.1	0.3	0.4
TOTAL -	3.7	1.3	1.6	3.4
Grasses				
Thickspike wheatgrass (Agropyron dasystachyum)	5.4	12.3	23.8	23.2
Fr. Junegrass (Koeleria cristata)	1.2	13.4	5.0	4.2
Needleandthread (Stipa comata and lettermani)	1.3	1.2	1.0	1.2
Indian ricegrass (Oryzopsis hymenoides)	0.8	1.1	0.5	0.6
Sandberg bluegrass (Poa secunda).	6.0	1.7	1.7	2.7
Bottlebush squirreltail (Sitanion hystrix)	1.3	3.0	Trc	0.8
TOTAL -	15.1	32.7	32.0	32.7
Bare Area	73.2	56.4	29.3	23.4

1/ Experimental area located on the Divide Grazing District, 26 miles west of Shelling, Wyoming, and 2 miles south on Highway 789. The 1957 vegetative survey was taken the same year as chemical application. Surveys have been made in 1958, 1959, and 1960 to determine the effect of chemical control of sagebrush upon the vegetative cover.

2/ Data are an average of 5,000 points taken on 50 acres by the point-transect method and indicate vegetation as observed from directly above. The 1958-72-60 data represent the average vegetative cover for all designs of sagebrush control.

3/ Other species: Bush muhly (Muhlenbergia racemosa) and a species of clover which contributed less than 0.2 percent abundance.

TABLE II. AVERAGE MOISTURE PERCENTAGE, BY WEIGHT, OF SPRAYED AND CHECK AREAS AT THREE DEPTHS OF SAMPLING BY MONTHS IN 1958, 1959, and 1960, ON THE RED DESERT.[1/]

Month	Depth in Inches																	
	6 - 7						12 - 13						18 - 19					
	1958		1959		1960		1958		1959		1960		1958		1959		1960	
	Sp.	Ck*	Sp.	Ck.	Sp.	Ck.	Sp.	Ck.	Sp.	Ck.	Sp.	Ck.	Sp.	Ck.	Sp.	Ck.	Sp.	Ck.
April					11.3	12.8					12.2	12.3					12.0	10.9
June			9.5	9.2	6.5	8.4			11.4	9.0	8.2	8.0			12.4	9.2	7.6	7.7
July	5.9	3.8	7.9	7.8	5.9	6.8	9.2	6.8	7.9	7.0	6.4	6.5	9.8	5.5	8.0	6.8	6.3	5.5
Aug.	5.5	5.9			2.8	5.8	6.1	5.5			4.7	6.6	5.9	4.7			5.7	6.1
Sept.	6.2	4.5	5.4	5.5			6.5	4.2	6.0	6.5			7.3	4.1	5.8		5.6	
Av.	6.2	4.7	7.6	7.5	6.6	8.4	7.3	5.5	8.4	7.5	7.9	8.3	7.7	4.8	8.7	7.2	7.9	7.5

* Sp. represents sprayed area where 80 to 100% of the sagebrush has been chemically controlled.
Ck. represents unsprayed live sagebrush areas.

Of references nonlocal Periodical Index

-Of references should also appear in footnotes and bibliography

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TABLE 3. AVERAGE MOISTURE PERCENTAGE BY WEIGHT OF SPRAYED AND CHECK AREAS AT THREE DIFFERENT SOIL DEPTHS ON THE RED DESERT IN 1958, 1959 AND 1960 1/

	Soil Depth in Inches							
	6 - 7		12 - 13		18 - 19		Average	
Year	Sprayed	Check	Sprayed	Check	Sprayed	Check	Sprayed	Check
1958	6.2	4.7	7.3	5.5	7.7	4.8	7.1	5.0
1959	7.5	7.6	8.2	8.4	8.7	7.2	8.1	7.7
1960	6.6	8.4	8.4	7.9	7.9	7.5	7.6	7.9
Av.:	6.8	6.9	8.0	7.3	8.1	6.5	7.6	6.9

1/ Average percentage moisture recorded in the soil for 1958, 1959, and 1960, regardless of month sampled.

TABLE 4. AVERAGE SOIL-MOISTURE TENSION OF SPRAYED AND CHECK AREAS AT THREE SOIL DEPTHS IN 1958, 1959, AND 1960, ON THE RED DESERT.

	Depth of Bouyoucos Blocks in the Soil							
Month	1958		1959		1960		Average	
	Sp.	Ck.	Sp.	Ck.	Sp.	Ck.	Sp.	Ck.
6-Inch depth								
April					1.0	0.9	1.0	0.9
June			1.0	1.0	8.5	9.6	4.8	5.3
July			7.3	15.0	13.3	15.0	10.3	15.0
August					15.0	15.0	15.0	15.0
September	15.0	15.0	12.2	14.9				
12-Inch depth								
April					0.9	1.1	0.9	1.0
June			0.7	1.0	2.8	7.6	1.7	4.3
July			5.9	13.6	12.3	13.6	9.1	13.6
August					15.0	12.7	15.0	12.7
September	15.0	15.0	10.7	14.5				
18-Inch depth								
April					1.0	0.9	1.0	0.9
June			0.9	0.8	2.1	4.1	1.5	2.4
July			6.4	10.5	12.9	11.1	9.6	10.8
August					12.8	14.7	12.8	14.7
September	15.0	15.0	12.1	11.3				

TABLE 3. AVERAGE MOISTURE PERCENTAGE BY WEIGHT OF CHANCO AND CHECK AREAS AT THREE DIFFERENT SOIL DEPTHS ON THE RED DESERT IN 1938, 1939 AND 1940 1/

Year	Soil Depth in Inches									
	6 - 7		12 - 13		18 - 19		Average			
	Chanco	Check	Chanco	Check	Chanco	Check	Chanco	Check		
1938	6.2	7.1	7.3	7.7	8.8	7.1	7.0			
1939	7.1	7.8	8.2	8.4	8.7	7.2	8.1	7.7		
1940	8.1	8.4	7.9	8.4	7.8	7.5	7.8	7.8		
Av.	6.8	6.4	8.0	7.3	8.1	6.5	7.6	6.9		

1/ Average percentage moisture recorded in the soil for 1938, 1939, and 1940, regardless of month sampled.

TABLE 4. AVERAGE SOIL-MOISTURE TENSION OF CHANCO AND CHECK AREAS AT THREE SOIL DEPTHS IN 1938, 1939, AND 1940, ON THE RED DESERT.

Month	Depth of Soil Sampled in the Soil									
	1938		1939		1940		Average			
	Ch.	Ck.	Ch.	Ck.	Ch.	Ck.	Ch.	Ck.		
6-Inch depth										
April					1.0	0.6	1.0	0.6		
June			1.0	1.0	8.5	9.8	9.8	5.3		
July			7.3	12.0	13.3	15.0	10.1	13.0		
August					13.0	13.0	13.0	13.0		
September			15.0	15.0	12.3	14.7				
12-Inch depth										
April					2.9	1.1	1.0	0.6		
June			0.7	1.0	2.4	2.5	1.7	4.3		
July			5.7	11.0	12.3	13.4	9.1	13.6		
August					13.0	13.2	13.0	13.7		
September			15.0	15.0	10.7	15.2				
18-Inch depth										
April					1.0	0.3	1.0	0.3		
June			0.4	0.8	2.1	1.1	1.5	2.4		
July			6.4	10.3	12.9	11.1	9.6	10.8		
August					13.8	10.7	13.8	14.7		
September			15.0	15.0	12.1	11.3				

SELECTION AND IMPROVEMENT OF SPECIES FOR DESERT AREAS

William A. Riedl, Loren Nelson, William W. Ellis, and R. L. Lang[1/]

The study to learn more about the desert-area forage species was continued in 1960 after the original investigation was initiated in 1957. Emphasis was placed on determining the variation in germination, seedling vigor, and subsequent growth of selections of Eurotia lanata. Chemical analyses of forage samples harvested at weekly intervals during the growing season were also made. In addition, soil samples from Eurotia lanata sites near Laramie were analyzed for pH, soil salinity, and settling volume.

Winterfat (Eurotia lanata) studies

Germination and seedling vigor of Eurotia lanata seed from two locations in each of three states--Wyoming, Nevada, and New Mexico--were studied. Table 1 shows the results of the germination tests. The highest germination (74 percent) was obtained from seed collected near Taos, New Mexico, and the lowest (32 percent) from that collected south of Ely, Nevada. There were no significant differences between the germination averages of the Eurotia lanata seed from the different states.

The germination percentage and the seedling-vigor readings were obtained on the seed from the open-pollinated progenies of high and low-vigor plants selected from two locations in Wyoming. Seed from the high-vigor plants gave an average of 75 percent germination and that from low-vigor plants an average of 85 percent. The seedling-vigor data have not been analyzed.

1/ Professor of Plant Breeding, Graduate Assistant, Associate Professor of Agricultural Biochemistry, and Professor of Range Management, respectively, Wyoming Agricultural Experiment Station.

SELECTION AND IMPROVEMENT OF
SPECIES FOR DESERT AREAS

William A. Rindt, Loren Nelson,
William E. Zillie, and R. L. Lang[1]

The study to learn more about the desert-area forage species was continued in 1960 after the original investigation was initiated in 1957. Emphasis was placed on determining the variation in germination, seedling vigor, and subsequent growth of selections of Eurotia lanata. Chemical analyses of forage samples harvested at weekly intervals during the growing season were also made. In addition, soil samples from Eurotia lanata sites near Laramie were analyzed for pH, soil salinity, and buffering volume.

Winterfat (Eurotia lanata) studies

Germination and seedling vigor of Eurotia lanata seed from two locations in each of three states--Wyoming, Nevada, and New Mexico--were studied. Table 1 shows the results of the germination tests. The highest germination (74 percent) was obtained from seed collected near Taos, New Mexico, and the lowest (12 percent) from that collected south of Ely, Nevada. There were no significant differences between the germination averages of the Eurotia lanata seed from the different states.

The germination percentage and the seedling-vigor readings were obtained on the seed from the open-pollinated progenies of high and low-vigor plants selected from two locations in Wyoming. Seed from the high-vigor plants gave an average of 73 percent germination and vigor data have not been analyzed. The seedling-

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1/ Professor of Plant Breeding, Graduate Assistant, Associate Professor of Agricultural Biochemistry, and Professor of Range Management, respectively, Wyoming Agricultural Experiment Station.

TABLE 1. Germination of Eurotia lanata seed from two locations in in Wyoming, Nevada, and New Mexico.*

Location	Percentage germination
Laramie, Wyoming	56
Pine Bluffs, Wyoming	52
Average for Wyoming	54
South of Ely, Nevada	32
Northwest of Ely, Nevada	62
Average for Nevada	47
Taos, New Mexico	74
Carrizozo, New Mexico	36
Average for New Mexico	55

* Data represents 8 replications of 50 seeds each

The seedling vigor of seedlings from monoecious and dioecious plants was studied but the data have not been completely analyzed at this time. Seed collected after October 15 had a higher germination percentage than that collected earlier. The seed collected at the later dates was more mature and more plump than seed collected before October 15. However, the largest, plumpest seed did not germinate as quickly as some of the smaller seed.

The germination and seedling vigor of seeds and seedlings from single-plant selections made in Spring Valley, Nevada, were studied. The germination varied from 65 to 97.5 percent. The seedling-vigor data have not been analyzed.

Low-vigor and high-vigor plants grown in the greenhouse were transplanted to the field in the spring of 1959. Vigor readings (plant height) were made on these plants in 1960. While these data have not been completely analyzed, it can be said that the high-vigor selections produced significantly taller plants than the low-vigor selections. In general, the high-vigor selections grew more rapidly, reaching a height of 15 to 16 inches at mid-August, while most of the low-vigor plants remained about the same height, or grew very slowly, reaching a height of only 2 to 3 inches. A higher percentage of the high-vigor plants produced seed than did the low-vigor plants. Seed from the low-vigor plants, in some cases, germinated better than seed from high-vigor plants. Many of the high-vigor plants became profusely branched, while most of the low-vigor plants produced only one stem.

Since chemical analyses were made on samples of Eurotia lanata forage gathered from a site near Laramie at weekly intervals from September 25 to October 21 in 1958, it was decided to determine the chemical composition of samples collected earlier in the season. In 1959, samples were gathered at weekly intervals from August 8 to September 19. The percentages of crude protein, ash, ether extract, lipid, crude fiber, calcium, and phosphorus were determined, but the data have not been completely analyzed. Succulence of the forage decreased from August 8 to September 19. The later samples were much drier. The mean crude-protein content was much higher when samples were collected during the growing period of August 8 to September 19 than when samples were collected September 25 to October 21.

Since Eurotia lanata is found in small patches on the Wyoming range, an attempt was made to find whether there were any soil relationships with the occurrence of this species. Soil samples were obtained from five Eurotia lanata sites near Laramie. The pH, soil salinity, and settling volume were obtained on these samples, and the results are shown in Table 2.

TABLE 2. Soil salinity, pH, and settling volume of soil from five Laramie sites of Eurotia lanata.

Location	pH		Soil salinity	Settling
	paste	dilution	EC_e in terms of mmhos. per cm.*	volume
North 9th Street	7.90	8.50	.25	18
So. Corthell Road	7.90	8.50	.40	16
West of Airport	7.80	8.40	.35	20
No. of Laramie	7.80	8.35	.35	21
West of Agron. Farm	7.85	8.30	.60	19

* Conductance of saturated extract.

Points to be noted in Table 2 are:

1. All of the samples were relatively high in pH.

2. The small difference in pH between the paste and dilution methods indicate that there is not much sodium present in the soil or, at least, it does not predominate. There was very little difference in pH between locations.

TABLE 2. Soil salinity, pH, and settling volume of soil from five Formosa sites of Eurycia longa.

Location	Soil salinity		pH		Settling volume
	paste	dilution		mmho. per cm.*	
North 9th Street	7.90	8.50	.45		18
So. Cortelyou Road	7.90	8.50	.40		16
West of Airport	7.80	8.60	.35		20
No. of Lorraine	7.80	8.45	.55		21
West of Agricul. Farm	7.85	8.30	.60		19

* Conductance of saturated extract.

Notice to be noted in Table 2 are:

1. All of the samples were relatively high in pH.

2. The small difference in pH between the paste and dilution methods indicate that there is not much sodium present in the soil or, at least, it does not predominate. There was very little difference in pH between locations.

3. There was only a slight increase in settling volume; this indicates little sodium in the soil.

4. Each soil sample was treated with dilute HCl, and all samples effervesced violently, indicating a high carbonate content in the soils.

5. All soil samples were sandy and reddish in color except samples from north of Laramie and west of the airport.

6. Soils from north of Laramie and west of the airport contained more clay than soils sampled from the other locations.

The results indicate that, on the sites near Laramie, Eurotia lanata was found on soil with a relative high pH, high carbonate, and low sodium content.

Other species for desert areas

Seed was collected from several superior selections of bluebunch wheatgrass (Agropyron spicatum). It is planned to increase the seed of these selections for further testing.

Indian ricegrass (Oryzopsis hymenoides) studies

A study was conducted in the greenhouse to determine if dormancy of Indian ricegrass seed was associated with a geographic strain. One hundred seeds from the 1958 seed crop and 100 from the 1959 seed crop of each of 68 strains were planted in vermiculite, and the germination recorded.

From the 1958 seed some germination was obtained from 35 strains of the 68 tested. A total of 227 seedlings emerged from 6,800 seeds planted. The highest germination from an individual strain was 32 percent.

From the 1959 seed, some germination was obtained from 21 strains of the 68 tested. The highest germination from a strain was 11 percent. A total of only 49 seedlings was obtained from the 6,800 seeds planted. This preliminary study indicates that high or low dormancy is not closely associated with geographic strains.

The Indian ricegrass nursery, established near Granger, Wyoming, was evaluated for plant survival and vigor on June 6 and 7 of 1960. Ratings of excellent, good, fair, and poor were based on the percentage survival and height and volume of leaf growth. Six of the strains were rated as excellent and eight were rated good. The remainder (73 strains) were rated as either fair or poor.

3. There was only a slight increase in existing volpest this
   indicates little sodium in the soil.

4. Each soil sample was treated with dilute HCl, and all samples effervesced violently, indicating a high carbonate content in the soils.

5. All soil samples were sandy and notched in color except samples from north of Laramie and west of the airport.

6. Soils from north of Laramie and west of the airport contained more clay than soils sampled from the other locations.

The results indicate that, on the sites here sampled, Douglas fir was found on soil with a relative high pH, high carbonates, and low organic content.

Other sources for desert grass

Seed was collected from several sources in Wyoming of Bluebunch wheatgrass (*Agropyron spicatum*). It is planned to increase the seed at Chase substations for further testing.

Indian ricegrass (*Oryzopsis hymenoides*) studies

A study was conducted in the greenhouse to determine if dormancy of Indian ricegrass seed was associated with a geographic strain. The material tested was from the 1938 seed crop and 100 from the 1939 seed crop harvested seeds from 88 stands were planted in vermiculite, and the germination recorded.

From the 1938 seed some germination was obtained from 35 strains of the 88 tested. A total of 227 seedlings emerged from 8,800 seeds planted. The highest germination from an individual strain was 32 percent.

From the 1939 seed, some germination was obtained from 21 strains of the 88 tested. The highest germination from a strain was 11 percent. A total of only 49 seedlings was obtained from the 6,800 seeds planted. This preliminary study indicates that high or low dormancy is not closely associated with geographic strains.

The Indian ricegrass nursery, established near Granger, Wyoming, was evaluated for plant survival and vigor on June 6 and 7 of 1940. Ratings of excellent, good, fair, and poor were based on the percentage survival and height and volume of leaf growth. Six of the strains were rated as excellent and eight were rated good. The remainder (13 strains) were rated as either fair or poor.